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Manipulation under general anesthesia with hydrodistention versus manipulation under general anesthesia with steroid injection in the treatment of frozen stage adhesive capsulitis of the shoulder

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ABSTRACT

Background and objective: Frozen shoulder can result in severe pain, stiffness, and movement failure. Anesthesia manipulation is on management method to control pain and improving motion under general anesthesia combined with hydrodistention or steroid injection. This study aimed to compare the effectiveness of manipulation under general anesthesia with hydrodistention versus manipulation under general anesthesia with steroid injection in the frozen shoulder treatment. *Patients and methods:* The present prospective study was conducted on 40 patients with frozen shoulder. Eighteen patients were treated with manipulation under general anesthesia and hydrodistention, and twenty-two with manipulation under general anesthesia and steroid injection. They were followed up in the one, three, and six-month after the treatment. At each follow-up, the patients' pain and disability were evaluated through the shoulder pain and disability index (SPADI) questionnaire. The collected data were analyzed through SPSS software. *Results:* The results revealed that most of the patients were females, aged over 60 years with an average of 56.38 years. Patients undergone manipulation under general anesthesia with hydrodistention and manipulation under general anesthesia with steroid injection were not significantly different regarding their total pain score, total disability score, and total spadi score at the base (p-value>0.05). A significantly difference was observed between them in terms of their pain score, total disability score, and total spadi score (p-value<0.001). *Conclusion:* In comparison with manipulation under general anesthesia with steroid

injection, manipulation under general anesthesia with hydrodistention was found significantly more effective in treating patients with frozen shoulder.

Keywords: manipulation under anesthesia, adhesive capsulitis, frozen shoulder, manipulation under general anesthesia, hydrodistention, steroid injection

1. INTRODUCTION

According to the American Orthopedic Association, frozen shoulder, also known as adhesive capsulitis is defined as a condition of varying severity in which global restriction of active and passive movement of shoulder develops gradually. In this condition, radiographic findings except for osteopenia are absent. The shoulder joint which is highly vulnerable to injury shows the widest range of movement in the body of human. It is not yet knows what causes frozen shoulder, and in most cases it usually resolves by itself within 12 to 24 months, sometimes taking up to 36 months. In this condition, as a result of capsule contraction and thickening, the shoulder hurts and becomes stiff (Georgiannos et al., 2017). Frozen shoulder is diagnosed by taking history and performing thorough clinical examination, radiographic assessment (plain radiography, CT, MRI) is not so helpful. The risk factors have been found to be prolonged immobilization, injury, hyperthyroidism, hypothyroidism, and diabetes (Cucchi et al., 2017).

Early mobilization following injury can prevent the condition. The course of the disease has three stages which are categorized based on slow resolution, stiffness and pain (Pandey & Madi, 2021). Therapies are mainly aimed at controlling the pain and restoring motion. The disease course and recovery have been found to be affected by patient awareness of the natural disease history and the significance of continuous conduction of home exercises. Pain management and muscle relaxation can be performed through some treatment options like using ultrasound, electric stimulation, heat, and ice in order to improve the role of manual techniques and exercises (Choi et al., 2019).

To treat frozen shoulder (FS), there is a wide range of treatment options, including exercise-based physiotherapy, steroid injection, and surgical intervention. The aim of all these treatments is to increase the individual's functional capacity (Nicholson et al., 2020). It has been proved that there is not therapeutic intervention which both relieves the pain completely and restores all motions (Favejee et al., 2011). There is very little evidence indicting appropriate method for managing frozen shoulders. As reported by a systematic review, there is no consensus or agreement over the effectiveness of steroid use, corticosteroid injections, or physiotherapy for managing frozen shoulder (Rookmoneea et al., 2010). Due to such an essential gap in the effectiveness evidence of proposed methods, nonsurgical treatments of frozen shoulder have been favored more (Lowe et al., 2019). As a result, high-quality, evidence-based effective treatment options are still required to improve clinical outcomes in patients who undergo nonsurgical treatments.

Another treatment option for frozen shoulder is hydrodistension (Nicholson et al., 2020). This treatment is interchangeably called "distension arthrography", "hydrodistension", and "hydrosilation". It is a therapeutic intervention for glenohumeral capsule contracture. The exact mechanism of distension is not fully known, but it includes the injection of a large amount of normal saline inside the joint. Hydrodistension reduces pain and improves movement by rupturing of capsular adhesions, capsular distension, stretching of pain receptors at the periosteal attachments and in the joint, and rupturing the subscapularis bursa (Favejee et al., 2011; Date & Rahman, 2020).

In comparison with some conservative management methods like medication and physical therapy, hydrodistension have been reported to provide better outcomes (Wu et al., 2017). It has also been evidenced that hydrodistension leads to further improvement in the range of movement of the external rotation over a short period of time (Yoon et al., 2016). Moreover, it brings about an elevated range of motion comparing to a single steroid injection (Mun & Baek, 2016). It has been reported that hydrodistension and guided exercise can be an effective nonsurgical treatment method; however, further research is required to further understand the value of hydrodistension as the first-line cure for frozen shoulder to be utilized in outpatient primary care clinics (Mun & Baek, 2016; Lewis, 2015).

Manipulation under general anesthesia consists of the controlled forced restoration of shoulder motion by utilizing a short lever arm to decrease the risk of causing a fracture. Abduction and flexion are usually restored prior to the anterior and inferior capsular structures are ruptured with internal and external rotation (Kraal et al., 2019). It has been reported that patients with shoulder stiffness improve after they undergo manipulation under general anesthesia, regardless of both resultsof the initial manipulation under general anesthesia and of the recurrence time (Woods & Loganathan, 2017). It has been shown that that combining manipulation under general anesthesia and limited capsular release for treating primary frozen shoulder is a safe and effective

procedure which results in a marked improvement in the movement range, function, and pain (Bidwai et al., 2016). Almost all of the mentioned studies are limited by the lack of a comparison group. Therefore, the present study was carried out in order to investigate the effectiveness of manipulation under general anesthesia with hydrodistention versus manipulation under general anesthesia with steroid injection in the treatment of the frozen shoulder.

2. PATIENTS AND METHODS

Setting and Study design

The present prospective study was carried out in Sulaimany teaching hospital and Shar teaching hospital from September 1, 2019 to September 1, 2020.

Study sample

The study sample consisted of 40 patients (8 males and 32 females) who had frozen shoulder and aged 40-69 years. The patients were chosen based on diagnostic prone of having frozen shoulder stage 2, limitation of movement in all directions, 3 months history of disease and failure of conservation therapy. Patients with trauma and/or fracture were elimiunated from the research. The plain radiography of all patients was normal.

Procedure and data collection

Eighteen patients were treated by manipulation under general anesthesia with hydrodistention (HD) and 22 by manipulation under general anesthesia with steroid injection. Patients who experience the manipulation under general anesthesia with hydrodistention were injected 100 to 200cc normal saline, and those who experience the manipulation under general anesthesia with steroid were injected 80 mg methylprednisolone. We started with manipulation under general anesthesia for both groups in supine position with an assistant stabilizing scapula in flexion in sagittal plane, external rotation in 0 then in 90 abduction, and internal rotation in 40 degree abduction and cross body adduction, then disinfection and injection of methylprednisolone or 100-200cc normal saline. Both groups started physiotherapy one day after operation.

In order to collect required data (i.e. pain, disability, and SPADI), the SPADI questionnaire developed by Roach et al., (1991) was utilized. This questionnaire is a self-administered scale which is aimed at collecting data on shoulder pain and functional activities. The section for pain assessment has 5 questions about the individual's pain severity. The section for functional activities has 8 questions aimed at measuring the individual's disability in carrying out daily activities. The total Spadi score is calculated based on pain and disability scores. The scores range from 0 (best) to 100 (worst). Validity and reliability of the questionnaire have been confirmed in a large number of studies.

Data analysis

The data collected before and after the operation and during the follow-up period on the 1st, 3rd, and 6th month following the operation was analyzed through SPSS software (version 25.0). T-test was employed to check the correlation between the collected data. P-value of <0.05 was regarded to be statistically significant.

Ethical considerations

Before the conduction of the study, the study protocol was approved by the Research Protocol Ethics Committee of Kurdistan Board of Medical Specialties (95-20/01/2020). In addition, patients' informed consent was achieved from the participants and they were provided with sufficient information about the duration and purpose of the study. They were also informed that they could leave the research at any time.

3. RESULTS

Based on the outcomes of the study, the patients aged between 40 and 69 years, with an average of 56.38±7.92 years and 19 (47.5%) being 60-69 years. Thirty-two (80%) patients were females, 31 (77.5%) were illiterate, and 28 (70%) were housewives. The associated diseases were hydrodilatation (HD) and diabetes mellitus (DM) in 15 (37.5%) patients and diabetes mellitus in 14 (35%) cases. Also, 38 (95%) had no previous surgery on the shoulder. Frozen shoulder was on the left side in 19 (47.5%) and on right side dominant in 14 (35%) (Table 1).

Table 1 Characteristics of the patient in groups

	Frequency (N)	Percentage (%)
Groups		
Manipulation under general anesthesia with hydro-distention	18	45.0
Manipulation under general anesthesia with steroid injection	22	55.0
Total	40	100.0
Age group (Mean age: 56.38±7.92 years)		
40 - 49	11	27.5
50 - 59	10	25.0
60 - 69	19	47.5
Total	40	100.0
Gender		
Male	8	20.0
Female	32	80.0
Total	40	100.0
Education level		
Illiterate	31	77.5
High school	7	17.5
Graduate	2	5.0
Total	40	100.0
Occupation		
Housewife	28	70.0
Employed	7	17.5
Unemployed	5	12.5
Total	40	100.0
PMH		
No past medical history	6	15.0
DM	14	35.0
HD	2	5.0
Auto immune disease	2	5.0
DM & HD	15	37.5
DM & Auto immune disease	1	2.5
Total	40	100.0
PSH		
Yes	2	5.0
No	38	95.0
Total	40	100.0
Side		
Right side	7	17.5
Left side	19	47.5
Right side dominant	14	35.0
Total	40	100.0

The average symptoms duration was 6.03 months. The total pain and total disability scores before the procedure were respectively 94.15 and 92.66, at 1-month follow-up 72.05 and 69.44, at 3-month follow-up 49.40 and 49.97, and at 6-month follow-up 29.25 and 30.84. The total Spadi scores and 1-, 3-, and 6-month follow-ups were respectively 129.44, 70.44, 49.75, and 30.23 (Table 2).

Table 2 Mean and standard deviation of pain, disability and Spadi scores at different stages

	Mean±SD	Min-Max
Duration of symptoms in months	6.03±1.73	3-10
Total pain score %	94.15±2.19	90-98
Total disability score %	92.66±2.97	82.50-97.50
Total pain score % 1 month	72.05±10.38	44-86
Total disability score % 1 month	69.44±11.04	41-89
Total pain score % 3 months	49.40±15.26	20-82
Total disability score % 3 months	49.97±14.51	23-81
Total pain score % 6 months	29.25±13.62	4-56
Total disability score % 6 months	30.84±13.46	4-63
Total spadi score base	129.44±3.08	120.00-133.08
Total spadi score 1 month	70.44±10.62	42.31-86.92
Total spadi score 3 months	49.75±14.63	21.54-81.54
Total spadi score 6 months	30.23±13.35	3.85-60.00

When comparing manipulation under general anesthesia with hydrodistention and manipulation under general anesthesia with steroid injection, there was not observed any significant differences between the two approaches in terms of total pain score (p-value=0.92), total disability score (p-value=0.20), and spadi score (p-value=0.48). However, after one, three, and six months of treatment, significant differences were observed between manipulation under general anesthesia with hydrodistention and manipulation under general anesthesia with steroid injection in terms of total pain score (p-value=<0.001). The results indicated that manipulation under general anesthesia with hydrodistention approach led to a significantly higher decrease in total pain compared to manipulation under general anesthesia with steroid injection approach. There were also significant differences between them regarding total disability scores after one, three, and six months of treatment (p-value=<0.001), such that manipulation under general anesthesia with hydrodistention approach resulted in a lower level of total disability compared to manipulation under general anesthesia with steroid injection approach. In terms of total spadi scores, the two approaches also differed significantly (p-value=<0.001), such that lower total spadi scores were obtained through manipulation under general anesthesia with hydrodistention approach compared to manipulation under general anesthesia with steroid injection approach (Table 3 and figure 1).

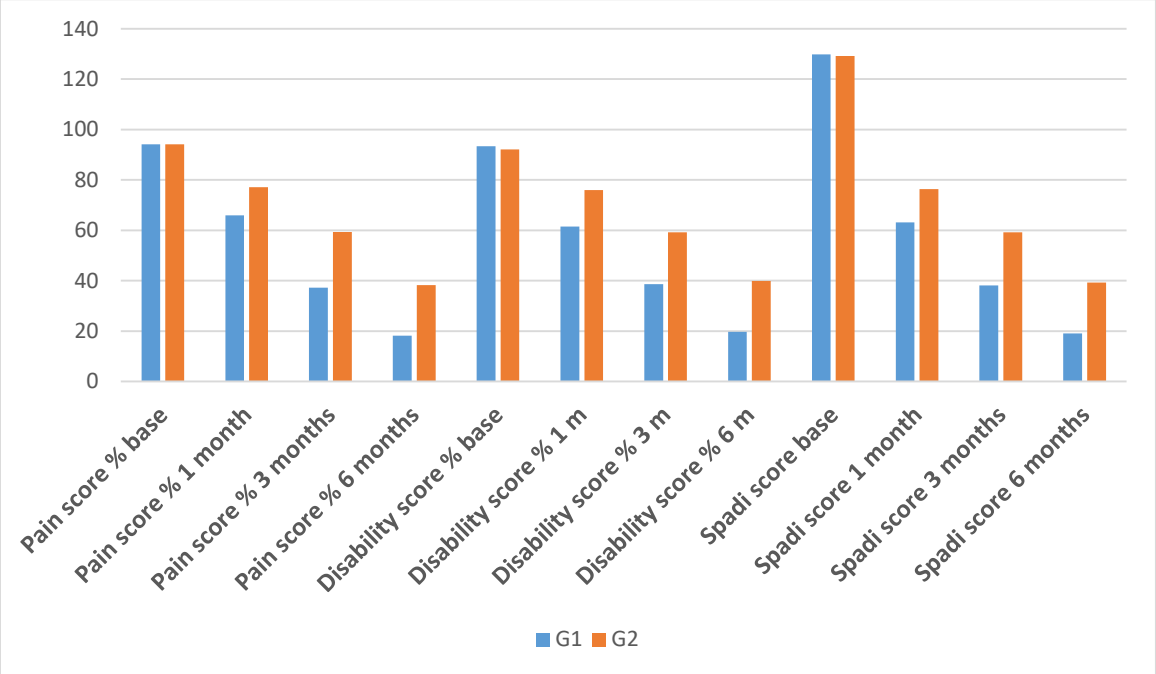

Figure 1 Bar chart of differences between manipulation under general anesthesia with hydrodistention (G1) and manipulation under general anesthesia with steroid injection (G2)

Table 3 Difference between manipulation under general anesthesia with hd and manipulation under general anesthesia with steroid injection groups in terms of pain, disability, and spadi scores

	Groups	Mean±SD	p-value
Total pain score % base	Manipulation under general anesthesia with hydrodistenstion	94.11±1.08	0.92
	Manipulation under general anesthesia with steroid injection	94.18±2.82	
Total pain score % 1 month	Manipulation under general anesthesia with hydrodistention	65.89±10.99	<0.001
	Manipulation under general anesthesia with steroid injection	77.09±6.58	
Total pain score % 3 months	Manipulation under general anesthesia with hydrodistention	37.22±11.06	<0.001
	Manipulation under general anesthesia with steroid injection	59.36±10.11	
Total pain score % 6 months	Manipulation under general anesthesia with hydrodistention	18.22±9.38	<0.001
	Manipulation under general anesthesia with steroid injection	38.27±9.14	
Total disability score % base	Manipulation under general anesthesia with hydrodistention	93.33±3.06	0.20
	Manipulation under general anesthesia with steroid injection	92.10±2.84	
Total disability score % 1 month	Manipulation under general anesthesia with hydrodistention	61.46±10.15	<0.001
	Manipulation under general anesthesia with steroid injection	75.97±6.63	
Total disability score % 3 months	Manipulation under general anesthesia with hydrodistention	38.68±10.25	<0.001
	Manipulation under general anesthesia with steroid injection	59.20±10.36	
Total disability score % 6 months	Manipulation under general anesthesia with hydrodistention	19.72±7.98	<0.001
	Manipulation under general anesthesia with steroid injection	39.94±9.59	
Total spadi score base	Manipulation under general anesthesia with hydrodistenstion	129.83±2.44	0.48
	Manipulation under general anesthesia with steroid injection	129.13±3.55	
Total spadi score 1 month	Manipulation under general anesthesia with hydrodistention	63.16±10.28	<0.001
	Manipulation under general anesthesia with steroid injection	76.40±6.44	
Total spadi score 3 months	Manipulation under general anesthesia with hydrodistention	38.12±10.40	<0.001
	Manipulation under general anesthesia with steroid injection	59.27±9.95	
Total spadi score 6 months	Manipulation under general anesthesia with hydrodistention	19.15±8.40	<0.001
	Manipulation under general anesthesia with steroid injection	39.30±9.08	

4. DISCUSSION

Peri-arthritis or adhesive capsulitis, frozen shoulder typically occurs around age 60 (Artus et al., 2014). Women develop frozen shoulder more than men. Similarly, most of individuals in the present study were females and aged over 60 years. Frozen shoulder can occur bilaterally, but it frequently affects the non-dominant shoulder, especially in diabetic patients (Date & Rahman, 2020). The frozen shoulder pathology is not understood, and no clear cause is found yet; however, some predisposing factors like rheumatoid arthritis, ischemic heart disease, trauma, cervical spine disorders, and diabetes mellitus have been reported to cause the disease (Tai & Lin, 2020). Moreover, there is a strong relationship between diabetes mellitus and idiopathic frozen shoulder (Rai et al., 2019; Abate et al., 2013).

Comparing to a single intra-articular injection of corticosteroid in primary frozen shoulder patients, hydrodistention in combination with manipulation under general anesthesia results in the relief of earlier pain and retrieval of movement range and function of shoulder (Mun & Baek, 2016). When conservative methods fail to relieve symptoms of frozen shoulder, manipulation under anesthesia manipulation under general anesthesia with steroid injection should be considered first in the management. Common treatments for frozen shoulder include manipulation under general anesthesia with arthroscopic capsular release and steroid injection. In their study, Thomas et al., (2011) reported that manipulation under general anesthesia and corticosteroid injection and local anesthetic resulted in a good outcome in individualswith primary frozen shoulder, independent of thesymptomsduration, and they reported that this improvement was retainedfor a long time.

In the present study, both methods of manipulation under general anesthesia with hydrodistention and manipulation under general anesthesia with steroid injection were used and compared with each other. Comparing these two methods revealed that there was no any significant differences between them in terms of the total pain score of base, total disability score of base, and total base score of spadi. However, after 1, 3, and 6 months of treatment, a significant difference was observed between manipulation under general anesthesia with hydrodistention and manipulation under general anesthesia with steroid injection in terms of total pain score. A similar study conducted by Jacobs et al., (2009) revealed that treatment through manipulation under general anesthesia with steroid injection is suggested for idiopathic primary frozen shoulder treatment, with the same clinical results as a manipulation under anesthetic with less attendant risks. In a similar study, Park et al., (2014) showed that an intra-articular injection of normal saline followed by manipulation under general anesthesia, compared with manipulation under general anesthesia alone, led to better results in patients.

Vastamaki et al., (2012) assessed 26 patients whose frozen shoulder had been treated through manipulation under general anesthesia. They observed an essential elevation in the movement range and pain relief over a period of 7 years. These also indicated that treatment with manipulation under general anesthesia led to improvement in movement range, function, and pain over a period of 23 years. However, it has been concluded that manipulation under general anesthesia with hd or steroid injection had equal results with manipulation under general anesthesia (Uppal et al., 2015). Pandey and Madi (2021) conducted the results of HD and manipulation for treatment of frozen shoulders. They observed that the HD group had significantly better constant scores compared to the manipulation group over a period of 6 months. In addition, at the final follow-up, satisfaction was reported by 94% of the HD patients and 81% of the manipulation group.

Rymaruk and Peach (2017) have reported that a large number of frozen shoulders are mild and can resolve with analgesics and physiotherapy. They also concluded that hydrodilatation can be used for short-term management of frozen shoulder for those patients who do not improve through analgesics and physiotherapy. They stated that hydrodilatation is not a standardized treatment plan, but it can be an appropriate option for patients with incomplete recovery. The outcomes of this study represented that manipulation under general anesthesia with hydrodistention led to a significantly higher decrease in total pain compared to manipulation under general anesthesia with steroid injection. Similarly, other studies have reported hydrodistension as a good method to giveshort-term advantages in relation to function, range of motion, and pain in individuals with frozen shoulder (Cho, 2021). Also, Haughton et al., (2018) reported results of hydrodistension in 76 patients with an average follow-up of 3.5 months. The Oxford shoulder score improved from an average of 20.6 before treatment to an average of 32.7 after treatment. Therefore, it is referred to hydrodistension as a treatment modality for short-term improvement of function, movement range, and pain.

Some studies have also reported good long-term outcomes following HD. For example, Clement et al., (2013) reported the effectiveness of hydrodistension in patients with FS over two years. In their study, they focused on SPADI, shoulder disability index, and range of motion. The results of their study revealed remarkable improvement in all outcomes over the follow-up period of 2 years. The results of their study also revealed similar results after arthrographic distension in 53 frozen shoulders with an average of 14 months follow-up. Saltychev et al., (2018) conducted a meta-analysis which focused on assessing the efficiency of hydrodistension in frozen shoulder treatment. The meta-analysis included 7 studies which had evaluated the substantial impact of

hydrodistension in combination with corticosteroid versus corticosteroid alone. The results showed that pain or range of motion was not remarkably affected by the volume of injected solution. It was also concluded that hydrodistension has just a small, clinically insignificant influence in the frozen shoulder treatment.

As revealed by the outcomes of this study, a significant difference was found between manipulation under general anesthesia with HD and manipulation under general anesthesia with steroid injection regarding the total spadi scores. Also, manipulation under general anesthesia with hydrodistention decreased total disability more than manipulation under general anesthesia with steroid injection. In line with the previous studies, it could be understood that manipulation under general anesthesia with hydrodistention is more sufficient than manipulation under general anesthesia with steroid injection in controlling the rate of disability in patients with frozen shoulder. It was stated that hydrodistension provides a treatment option for frozen shoulder patients that is relatively cheap and quick, and if delivered in primary care, easily accessible, reducing the need to progress to surgery. This primary care delivered treatment can show a significant influence on healthcare costs and patient's management and experiences (Rae et al., 2020). After comparing the effectiveness of manipulation under general anesthesia with hydrodistention versus manipulation under general anesthesia with steroid injection in frozen shoulder treatment in their study Bryant et al., (2017) reported that management of frozen shoulder stages II and III, as performed by physiotherapists in a primary care setting using hydrodistension and a guided exercise program, represents a more effective non-operative treatment strategy. In line with the results reported by previous studies, the approach of manipulation under general anesthesia with hydrodistention resulted in a higher decrease in total SPADI scores in comparison with manipulation under general anesthesia with steroid injection.

5. CONCLUSION

Manipulation under general anesthesia was found to be beneficial in most cases. Timing may have an effect on outcomes of manipulation of the idiopathic frozen shoulder. If non-surgical treatment cannot reduce the pain or restriction of shoulder movement is too severe, the best time to manipulate under general anesthesia might be between 1 and 6 months from beginning of symptoms. This study revealed that manipulation under general anesthesia with hydrodistention approach led to a significantly higher decrease in total pain compared to manipulation under general anesthesia with steroid injection approach. Finally, the comparison between these two methods revealed that manipulation under general anesthesia with hydrodistention is more beneficial in frozen shoulder treatment compared with manipulation under general anesthesia with steroid injection.

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Author Contributions

Designed study: Ali Abdalnabi Alwan Al-tamimi, sample collection: Aso Khalil Mahmood. Data analysis: Ali Abdalnabi Alwan Al-Tamimi, Areewan Muhammadsalih Saeed, Wrote the paper: Aso Khalil Mahmood

Ethical approval

The study was approved by the Research Protocol Ethics Committee of Kurdistan Board of Medical Specialties University (ethical approval code: 95-20/01/2020).

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Conflict of Interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are presented in the paper.

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